

Sensory modulation interventions for adults with mental illness: A scoping review

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Abstract

Introduction: Sensory Modulation Interventions (SMI) assist people with mental illnesses to regulate emotional and physiological arousal. We aimed to conduct a scoping review to identify the study designs, geographical distribution, modality/regimen, barriers and facilitators in using SMI for individuals with mental illnesses.

Methods: A systematic search was conducted using Arksey and O'Malley's framework with studies published on SMI from January 2010 to November 2020.

Results: 17 articles were found to be relevant. One was a case-control study, qualitative ($N = 3$), mixed-method ($N = 3$), and case studies ($N = 3$), and the rest were pilot interventional studies ($N = 8$). The duration of sessions ranged from 2 to 30 minutes for 2 days to 3 years. The facilitators in using SMI were of being cost-effective and easily adaptable. Barriers were in terms of maintenance of sensory items. Sensory modulation based items related to proprioception, vestibular and tactile were the frequently used in the SMI based interventions used in the included studies.

Conclusions: SMI as an occupational therapy intervention for individuals with mental illnesses is evolving and more robust studies in the future are recommended.

Keywords

Sensory modulation, mental illness, occupational therapy interventions, adults, occupational therapy

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Introduction

Maladjustments in the psychological, biological, or developmental processes of an individual's mental functioning that is characterized by disturbances in their emotions, thoughts, or behavior, is termed as mental illness which consists of a wide range of symptoms and problems, that may lead to issues with self-care, education, work, social, and family activities (American Psychiatric Association, 2019). Mental disorders have graduation in gravity, from absence to critical psychopathology; but are not inflexible phenomena. Some examples of mental illnesses are depression, schizophrenia, intellectual disabilities, and disorders related to substance abuse (World Health Organization, 2019).

Mental illnesses affect education and income levels, and it is seen in all cultures. The global economic and societal burden of mental health disorders is rising at a startling rate (Gmitroski et al., 2018). Moreover, the burden of mental illness and addictions is said to be larger than the burden of illness for other medical conditions, such as cancer and

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infectious diseases (Ratnasingham et al., 2013). Improving the occupational participation of individuals with mental illnesses may aid in reducing this burden of mental illness as a contribution to the society (Lannigan & Susan Noyes, 2019; Lipskaya-Velikovsky et al., 2015).

Sensory Modulation is the neurological ability of the central nervous system to regulate the sensory stimulus received from the environment that provides an opportunity for a behavioral response to that stimulus (Brown et al., 2019). According to Dunn's model of sensory processing (Dunn, 2001), people with low registration do not notice sensory events in daily life that are immediately noticed by most people because they have high thresholds and passive response strategies. In contrast, people with sensory sensitivity notice much more sensory stimuli than most people and get easily distracted because they have low thresholds and passive response strategies. Sensory seekers actively use strategies to look for sensory input, while the sensory avoiders actively limit sensory-input (Sharfi & Rosenblum, 2015).

Studies have shown that persons with bipolar face low registration, sensory sensitivity, and sensory avoidance problems (Engel-Yeger et al., 2016). Additionally, people with mental disorders such as schizophrenia experience sensory modulation disorders with an under responsiveness, which in turn may influence the participation dimensions, thus affecting mental health (Lipskaya-Velikovsky et al., 2015). There are two concepts when referring to the term sensory modulation. One refers to physiological sensory modulation, which is the neurophysiological reaction that alters cellular mechanisms for habituation and sensitization. The second refers to the behavioral sensory modulation, which is the ability to appropriately regulate and organize sensory responses (Brown et al., 2019).

Individuals with significant mental illness have distinct sensory processing patterns in contrast to the general population and the evaluation of these sensory processing patterns in adults with significant mental illness can inform sensory-based treatment (Pfeiffer et al., 2014). The sensory based interventions aim at all seven senses: visual, tactile, gustatory, auditory, olfactory, vestibular systems, and proprioceptive (Machingura et al., 2018). Interventions that are based on sensory modulation could assist individuals to regulate emotional and physiological arousal. Sensory Modulation Intervention (SMI) has been highlighted as a non-invasive, self-directed, and empowering intervention that may support recovery and inform mental health practice (Scanlan & Novak, 2015). When people with mental illnesses are provided with SMIs that are nurturing such as gliding in a glider rocker while wrapped in a weighted blanket, it provides them the required sensorimotor opportunities to function adequately in their daily lives. The application of sensory modulation strategies has been proven to be helpful and supportive of functional

performance, thus occupational therapists use SMI to help individuals to self-regulate through the process of self-organization and positive change (Champagne, 2011).

SMIs comprise of activities and modalities which are designed to facilitate specific types as well as amounts of sensation, at a given time, for therapeutic purposes (Machingura et al., 2018). When implementing a sensory modulation approach in mental healthcare facilities, there is a significant effect on the reduction of seclusion and restraints (Andersen et al., 2017). SMIs can help individuals to develop appropriate behavioral responses by enabling the processing of sensory information and facilitating effective occupational participation (Machingura et al., 2018).

When individuals encounter mental health crises, there could be increased levels of stress, cognitive, perceptual changes, and emotional distress, which might result in hyper or hyposensitivity to various sensory inputs (Bar-Shalita, et al., 2012). By altering the environment and using soothing stimulus, we can attain moderate or suitable arousal. It enhances the ability to adapt and regulate emotions (Machingura et al., 2018). Perceived unpleasantness due to various experiences and coping mechanisms tends to impact the lives of individuals in terms of time, thought, effort, and choices concerning social activities (Pfeiffer & Kinnealey, 2003). There is a relationship between sensory defensiveness and anxiety, and by following an intervention that is designed for individuals with sensory modulation disorder, both sensory defensiveness and anxiety could drastically decrease (Machingura et al., 2018). So, SMIs could impact sensory defensiveness and anxiety and assist individuals to improve their productivity and the quality of life (Pfeiffer & Kinnealey, 2003). By appropriately using sensory modulation strategies, we could provide experiential and alternative opportunities for de-escalation, empowerment, choice, increasing awareness, and skill development (Reed, 2017). An example of a SMI is a sensory room. A sensory room could help calm and alert the senses. A sensory room program aims to facilitate an environment for client-centered practice to provide opportunities for exploring self-regulation of emotions and acquisition of new coping skills to prevent or de-escalate aggressive behaviors. A sensory room is designed for goals that focus on de-escalation or prevention (Reed, 2017).

Since SMIs for adults with mental illness is evolving, a scoping review is the research method of choice at this point in time to map the existing literature in this field to inform further advance. Earlier review by Machingura et al., (2018) has mapped the literature on use of sensory modulations on adults with only schizophrenia. Since recently there has been an increased interest in the area of sensory modulation for persons with mental illness there are possibilities of having further studies after the last review done by Scanlan and Novak (2015). Hence, the current review will serve to recognize the recent advancement in the domain of SMIs for

adults with mental illnesses. This will assist in identifying the application of related strategies in the occupational therapy clinical practice, and to further advance the research in this area.

We generated the following exploratory research question that will allow us to broaden our search. *What is the available literature on the occupational therapy based sensory modulation interventions for adults with mental illness?* On this basis, we formulated the objectives that include studying the existing literature on the sensory modulation interventions for adults with mental illnesses by identifying the range of study designs used, the geographical distribution, the modality/regimen used in studies related to the sensory modulation interventions for adults with mental illness and also to recognize the barriers and facilitators of utilizing the sensory modulation interventions for mental illness.

Methods

Search strategy

A scoping review is a method of mapping the core theories and concepts of a research area and synthesizing all possible evidence from both published and grey literature, through a broad search (Arksey & O'Malley, 2005; Levac et al., 2010; Munn et al., 2018). A scoping review helps in identifying and organizing the fundamental concepts, sources, and types of evidence available, which informs practice in the research area. It also helps in recognizing and analyzing knowledge gaps, identify the value, potential, and cost of executing a full systematic review, and in compiling and disseminating research findings (Arksey & O'Malley, 2005; Levac et al., 2010; Munn et al., 2018).

Arksey and O'Malley's (Arksey & O'Malley, 2005) framework for scoping reviews was used in the current review to identify the extent of research done in the domain of SMI for adults with mental illnesses (Figure 1). The following databases were chosen for the review -PubMed/MEDLINE, CINAHL Complete, Scopus, Web of Science, Sage Journals, ProQuest, Springer Link, and OT Seeker as these are the databases in which majority of the occupational therapy research is published. The keywords for population (mentally ill OR mental illness OR psychiatric illness) and intervention (sensory modulation OR sensory integration OR sensory based) were combined with Boolean operators for the literature search. The search was conducted in the month of September 2020.

Study selection criteria

A total of 159 articles were obtained from the included databases by the first four authors. After removing the duplicate articles, a total of 144 articles remained. The titles and abstracts of the retrieved articles were screened by the

first four authors (NK, SJ, AF, SR) independently, out of which 117 articles were excluded for reasons being that the studies were either related to imaging, neurotransmitters, drug therapy, neuro mechanisms, were observational studies or were not interventional studies. If any discrepancy existed between the reviewers, the fifth author (SQ) was consulted and final decision was taken (Figure 1). The obtained 27 articles were reviewed full text and finally a total of 17 full text articles were included based on the following inclusion criteria: (i) Articles available in full-text and published in English, from January 2010 to September 2020 so as to identify the recent research done in the field of SMI (ii) studies done on adult mental illnesses as defined in the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5) and International Statistical Classification of Diseases and Related Health Problem, 10th version (ICD-10), (iii) studies on adults of ages 18+ years, (iv) SM interventional studies including qualitative studies. Exclusion criteria were as follows: (i) SMI studies conducted on the pediatric population, (ii) studies done on SMI for adults with attention deficit hyperactivity disorder (ADHD), autism spectrum disorder (ASD), and neuropsychiatric conditions like dementia, TBI, etc., (iii) studies on hearing, vision, or similar sensory impairments and, (iv) letters to the editor, correspondence, editorials, fact sheets, and viewpoints on SMI. Studies done on persons with ASD and ADHD were excluded in the current review as the focus of the current review was to identify literature on use of SMIs only in mental illnesses or psychiatric conditions. The obtained final 17 articles were reviewed by all the authors and the data was charted and collated.

Results

Description of the included studies

A total of 17 articles were included in the present review after adhering to the inclusion/exclusion criteria. Most studies ($N = 13$) published between the year 2013–2019 (Adams-Leask et al., 2018; Andersen et al., 2017; Blair et al., 2017; Champagne et al., 2015; Gardner, 2016; Hollands et al., 2015; Lloyd et al., 2014; Smith & Jones, 2013; Sokmen & Watters, 2016; Sutton et al., 2013; Sylvia et al., 2014; Wallis et al., 2018; Wigglesworth & Farnworth, 2016). The study details are charted in Table 1.

Out of the 17 studies included, 6 each were from North America (Blair et al., 2017; Champagne et al., 2015; Gardner, 2016; Kaiser et al., 2010; Knight et al., 2010; Sylvia et al., 2014) and European continent (Andersen et al., 2017; Hollands et al., 2015; Smith & Jones, 2013; Sokmen & Watters, 2016; Sutton et al., 2013; Wallis et al., 2018) and 5 were from Australian continent (Adams-Leask et al., 2018; Chalmers et al., 2012; Lee, Cox, Whitecross, Williams, & Hollander, 2010; Lloyd et al., 2014; Wigglesworth & Farnworth, 2016).

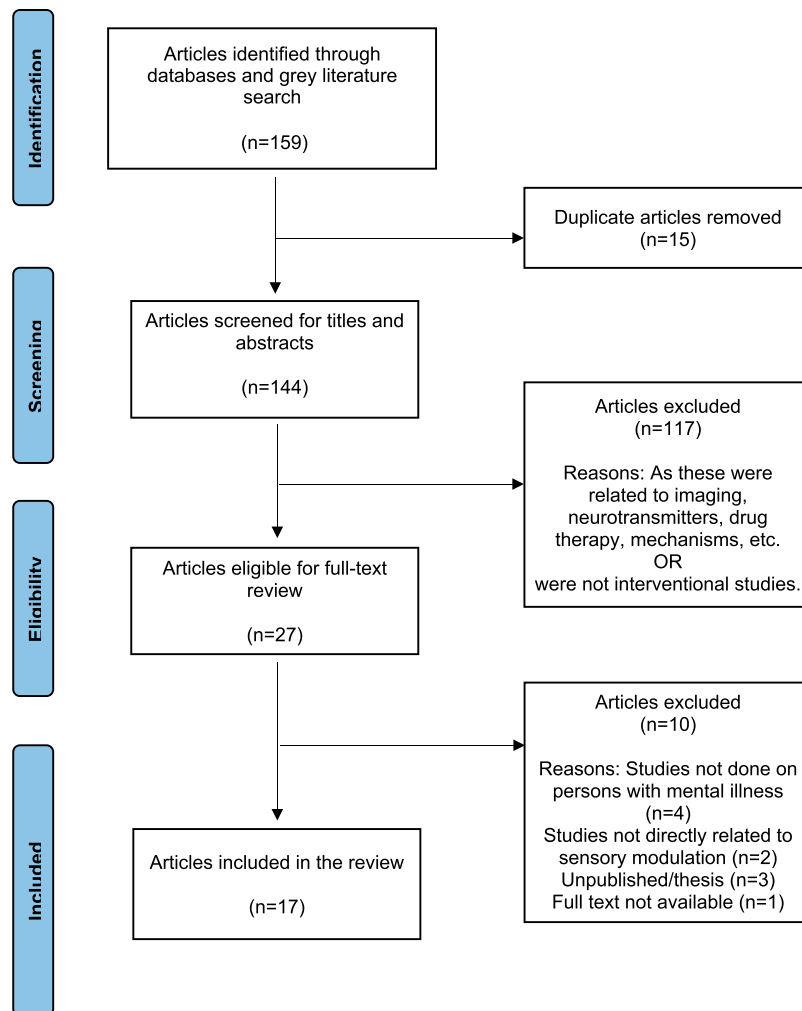


Figure 1. PRISMA Flow Chart.

Only one study was a case control study (Andersen et al., 2017) with the rest being either pilot pre-post interventional (Adams-Leask et al., 2018; Blair et al., 2017; Chalmers et al., 2012; Champagne et al., 2015; Gardner, 2016; Kaiser et al., 2010; Knight et al., 2010; Lee et al., 2010), qualitative (Hollands et al., 2015; Lloyd et al., 2014; Sutton et al., 2013), mixed method studies (Smith & Jones, 2013; Sokmen & Watters, 2016; Wallis et al., 2018; Wigglesworth & Farnworth, 2016) or single case study (Sylvia et al., 2014).

Out of the 17 studies reviewed, only one study reported of no specific effects of SMI (Smith & Jones, 2013). The other studies reviewed identified the effect of SMI on improved arousal levels (Chalmers et al., 2012; Gardner, 2016; Sokmen & Watters, 2016), reduced anxiety (Champagne et al., 2015; Sylvia et al., 2014; Wallis et al., 2018), stress (Wigglesworth & Farnworth, 2016), distress (Adams-Leask et al., 2018; Lloyd et al.,

2014), agitation (Sutton et al., 2013) and somatic concerns (Knight et al., 2010; Sylvia et al., 2014). SMI was found to induce a self-soothing effect (Sokmen & Watters, 2016; Sutton et al., 2013), helped in better self-perception (Hollands et al., 2015; Kaiser et al., 2010), emotional regulation (Hollands et al., 2015; Kaiser et al., 2010; Knight et al., 2010; Sokmen & Watters, 2016), self-management and interpersonal engagement (Sutton et al., 2013). Also, SMI was found to be beneficial in reducing forced medication intake (Andersen et al., 2017) and improved occupational performance (Wallis et al., 2018).

Age and diagnosis of the participants

The age of the participants in the included studies ranged from 18–92 years. The diagnosis of the participants included in the studies were mood disorder (Adams-Leask

Table 1. Data Chart of the Included Studies.

Sl. No.	Author & year	Study design	Location	Setting/Population	Age	No. of participants	Diagnosis	Results of the study
1	Adams-Leask et al., 2018	Pilot non-randomized interventional study	Australia	Emergency department of a major tertiary teaching hospital	Age - 17–60 years	N = 74	Diagnosis: Mood disorders – 25, neurotic, stress-related and somatoform disorders - 19 Disorders of adult personality and behavior - 17 Schizophrenia, schizotypal and delusional disorders - 9 Mental and behavioral disorders due to psychoactive substance use - 7	SMI were effective in reducing distress
2	Andersen et al., 2017	Case control study	Denmark	Psychiatric open unit	Age - 18–65 years	Patients admitted during 12 months	Diagnosis: Schizophrenia, bipolar disorder, and depression	SMI was effective in reducing belt restraints and forced medication
3	Blair et al., 2017	Pilot pre-post interventional study	USA	Psychiatric service unit	Age - 12–66 years	N = 8029	Diagnosis - not specified	SMI was effective in reducing seclusion and restraint use
4	Chalmers et al., 2012	Interventional study	Australia	Acute adult psychiatric inpatient unit	Age – not specified	N = 109	Diagnoses: Not specified	SMI was effective in reducing arousal levels
5	Champagne et al., 2015	Pilot exploratory study	USA	Acute care mental health unit	Age - 18 – 54 years	N = 30	Diagnoses not specified	SMI was effective in reducing anxiety levels
6	Gardner, 2016	Pilot pre-post interventional study	USA	Adult inpatient psychiatric unit	Age - 19–68 years	N = 20	Diagnosis: Thought disorders (85%) Psychosis NOS – 8, schizophrenia, paranoid type - 7	SMI was effective in reducing self-perceived arousal levels
7	Hollands et al., 2015	Qualitative study	New Zealand	Mental health service	Age - 18 years and above	N = 3	Diagnosis: Not specified	SMI was effective in gaining a sense of connection and identity, physicality and embodied emotion

(continued)

Table I. (continued)

Sl. No.	Author & year	Study design	Location	Setting/Population	Age	No. of participants	Diagnosis	Results of the study
8	Kaiser et al., 2010	Pilot controlled study	USA	Mental health clinic	Age - 34–62 years	N = 10	Diagnosis: PTSD – 5 Major depression – 4 Anxiety disorders - 4	SMI was effective in improving self-perception, affect/impulse regulation and alterations in meaning
9	Knight et al., 2010	Pilot non-experimental two-group study	North America	One general psychiatry unit and one geriatric neuropsychiatry unit	Age - geriatric neuropsychiatry (66–92 years) and psychiatric unit (18–51 years)	N = 24	Diagnosis: Not specified	SMI was effective in reducing blunted affect, emotional withdrawal, somatic concerns
10	Lee et al., 2010	Pilot pre-post interventional study	Australia	Acute psychiatric unit	Age: Not specified	N = 43	Psychotic disorders, bipolar disorder, major depression	SMI was effective in reducing seclusion rates
11	Lloyd et al., 2014	Naturalistic study	Australia	Acute adult mental health unit	Age not specified	N not specified	Diagnosis: Not specified	SMI was effective in reducing the distress levels. Group not using SMI showed increased seclusion rates
12	Smith and Jones, 2013	Mixed method pre-post study	UK	Psychiatric intensive care unit (PICU)	Age: - Not specified	N = 7	Diagnosis: Not specified	No significant difference in seclusion rates by using SMI
13	Sokmen & Watters, 2016	Multiple case study -mixed method	New Zealand	Mental health and addiction centre	Age – not specified	N = 6	Diagnosis: Borderline personality disorder posttraumatic stress disorder Eating disorder bipolar affective disorder Depressive episodes Dependent personality disorder	SMI was effective in modulating arousal levels resulting in a self-soothing effect, improvement in emotion regulation
14	Sutton et al., 2013	Qualitative – inductive study	New Zealand	Four inpatient mental health units	Age not specified	N not specified	Diagnosis: Not specified	SMI was effective in facilitating calm state, enhanced interpersonal engagement, supported self-management and managing agitation

(continued)

Table 1. (continued)

Sl. No.	Author & year	Study design	Location	Setting/Population	Age	No. of participants	Diagnosis	Results of the study
15	Sylvia et al., 2014	Single case study	North America	Psychiatric unit	Age - 30 years	N = 1	Diagnosis: Bipolar I disorder with comorbid endometriosis, dyslexia, ADHD, and anxiety disorder not otherwise specified	SMI was effective in reducing anxiety and somatic symptoms
16	Wallis et al., 2018	Mixed method single subject case design	New Zealand	Adult mental health community service	Age - 32, 46, 18, 46 years	N = 4	Diagnosis: Anxiety	SMI was effective in reduction of anxiety, increase in participation levels and improved performance and satisfaction in occupational performance
17	Wiglesworth & Farnworth, 2016	Mixed method – two groups	Australia	Forensic mental health setting	Age - 18–60 years	N – not specified	Diagnosis: Schizophrenia and other psychotic disorders Depression Personality disorders Bipolar disorder Alcohol or drug abuse/dependence Intellectual disabilities	SMI was effective in reducing stress levels

Note. SMI – Sensory Modulation Intervention.

et al., 2018; Andersen et al., 2017; Lee et al., 2010; Sokmen & Watters, 2016; Sylvia et al., 2014; Wiglesworth & Farnworth, 2016), neurotic and stress related disorder (Adams-Leask et al., 2018; Kaiser et al., 2010; Sokmen & Watters, 2016; Wallis et al., 2018), personality disorder (Adams-Leask et al., 2018; Sokmen & Watters, 2016; Wiglesworth & Farnworth, 2016), schizophrenia (Adams-Leask et al., 2018; Andersen et al., 2017; Gardner, 2016; Wiglesworth & Farnworth, 2016), substance use disorder (Adams-Leask et al., 2018; Wiglesworth & Farnworth, 2016), depression (Andersen et al., 2017; Kaiser et al., 2010; Lee et al., 2010; Sokmen & Watters, 2016; Wiglesworth & Farnworth, 2016), specifically thought disorder (Gardner, 2016), and psychosis (Gardner, 2016; Lee et al., 2010).

Facilitators and barriers in using sensory modulation interventions

The authors of the reviewed articles have reported of facilitators such as SMIs being cost-effective intervention and could be delivered bedside or via mobile trolleys or sensory boxes (Adams-Leask et al., 2018). SMIs are easily adaptable and are found to improve the environment on the unit, creating a safer space for all, both inpatients as well as personnel (Andersen et al., 2017). A small room is usually sufficient to provide SMI (Chalmers et al., 2012). Barriers in implementing SMIs were the cost of supplying sensory items as it is ongoing as the items used may be lost or broken and about consistency in the use of items was found to be an issue (Chalmers et al., 2012). Since, the items had to be kept

Table 2. Details of SMI Used.

Sl. No.	Author & year	Details of SMI used	Time specifics of SMI
1	Adams-Leask et al., 2018	Sensory modulation based items from a mobile trolley or sensory box including hand fidgets colored lights, weighted blanket coconut sand lollies/candy, olfactory items (e.g. fresh rosemary leaves or lavender), tactile items (e.g. bubble wrap, sensory water beads), visual items (e.g. Bright LED soft pillow, sea shells, sand timer) other (e.g. guitar, massage pad). If taken up, consumers engaged with preferred items for as long as they wished. Consumers used between one and six types of items at a time	20 minutes-2.5 hours, median of 2 days
2	Andersen et al., 2017	Individualized sensory plans for the patients including ball blankets, a ball chair, large therapy ball, therapeutic music, and nintendo wii sports games, etc., could be treated individually or in groups depending on their level of agitation	Not specified
3	Blair et al., 2017	Environmental enhancements included assessing the patient's "sensory diet" on admission (e.g., identifying personalized coping strategies for decreasing anxiety/agitation) and creating comfort rooms (e.g., areas with calming lights, sensory items, music)	2 years
4	Chalmers et al., 2012	Glider chair, murals, chalk boards and sound boards, soft furnishings, a bean bag, relaxing music and stress balls, massage chair, bean bags, music, a variety of lighting, lollies, self-help books, stress balls, water feature, and a 'swiss ball' (large inflatable exercise ball)	Around 3 years
5	Champagne et al., 2015	30-Pound weighted blanket	5 minutes, 2 sessions
6	Gardner, 2016	Group or individual sessions using blankets, handout that lists various isometric exercises, disc 'o' sit cushion, seat cushions, yoga mat with pictures of various positions, journals, puzzles, construction paper, markers, colored pencils, paper, crossword puzzles, search or word puzzles, magazines, bible, koran, spiritual books, alcoholics anonymous and narcotics anonymous materials, stress balls, widgets, Rubik's cubes, clay, vibrating gadgets, beanbags, scented lotions, scented candles, scented body sprays, oranges, linen sprays, cinnamon sticks, potpourri, peppermints, chewing gum, starburst candies, crackers, cookies, pretzels, ice cubes, CD discmans with a variety of music, including classical, rhythm and blues, gospel, country, relaxation, and hip hop, rain sticks	3 sessions per week for 6 weeks resulting in 19 sessions
7	Hollands et al., 2015	Group performance of haka (war dance), m.teatea (traditional chant), modern poi (A light ball on a string which is swung or twirled rhythmically to sung accompaniment), and waiata--ringa (action song)	Not specified
8	Kaiser et al., 2010	Individual interventions with trochoidal motion table, computerized light instrument, and acoustic training suite	30 days, for 20 minutes
9	Knight et al., 2010	Music, items that could be squeezed or manipulated, rocking chairs, visual activities (e.g., fish tanks, calming videos), sound (e.g., chirping birds, water), scent, and touching/building with wooden blocks	30 minute sessions
10	Lee et al., 2010	Musical instruments or listening equipment e.g. MP3 player, drums, guitar tactile balls or putty weighted blanket art or craft optic lamp distortion glasses card or board games massagers aromatherapy rocking chair	6 months
11	Lloyd et al., 2014	Sessions were either patient or staff initiated. Items included hand squeeze equipment, yoga, loafahs, bean bag, self-massage tools, weighted therapy balls, manicure, crunchy foods, vibration, bubble lamp, bubbles, computer use, colored sunglasses, rocking chair, glider rocker, guided imagery, musical instruments, candles, eucalyptus, lemon, spices, etc.	2 group sessions for 90 minutes each

(continued)

Table 2. (continued)

Sl. No.	Author & year	Details of SMI used	Time specifics of SMI
12	Smith and Jones, 2013	Sensory room had light blue painted walls, laminated flooring and one window which had a black out roller blind, a large floor mounted bubble tube, an optic mat, a light/image emitting projector, two lying bean bags, two sitting bean bags, a variety of cushions, an iPod dock/iPod and drawers containing: magazines, stress relief toys, chewing gum and educational materials promoting relaxation and healthy living	13 months
13	Sokmen & Watters, 2016	Self-soothing kit including music or radio (all), creative/gratitude journaling, scents in vials or scented candles, texts and guided audio recordings of the pebble meditations with self-decorated stones, painting, bracelet, elastic bands and other jewellery making, doodling and zentangles, colouring-in, plasticine and fimo, card making, and gardening	15 minutes to 3 hours
14	Sutton et al., 2013	Sensory room including soothing music, watching colored lights, blowing bubbles, and doing plastic maze puzzles, weighted blankets, massage chair, and other items	Around 2 years
15	Sylvia et al., 2014	Wearing glasses with lightly tinted lens (e.g., pink, orange), bringing something along that could be chewed on, auditory training (e.g., listening to electronically modified music), carrying something that could be squeezed in hand (e.g., koosh ball), or brushing skin with light, soft brushes. Using a weighted blanket and continuing to use the deep touch pressure strategies that the patient had already identified (e.g., wrapping or swaddling in blankets, swinging in a tightly enclosed hammock, asking friends to apply pressure to back and shoulders)	2 months
16	Wallis et al., 2018	Weighted blankets, yuckee balls, and wraps as well as identifying sensory tools	6 weeks, each session for 1 hour
17	Wiglesworth & Farnworth, 2016	Sensory room having range of colors through a strip of LED (light emitting diode) lighting and choose from various calming projector images including a green forest scene or fish and bubbles, which roll across the walls, sound audio system, seating options of a couch or beanbags, and sensory items including soft toys, scented moisturizers, weighted items, aromatherapy oils and bubble mixture	Not specified

Note. SMI – Sensory Modulation Intervention.

locked concerning the safety, the accessibility of items to persons with mental illnesses whenever they need was another issue faced (Lee et al., 2010). Another concern was about the nonspecific factors such as attention, degree of involvement, and expectancy during SMI requiring extensive contact and involvement (Kaiser et al., 2010) especially when more than one person uses the space (Wiglesworth & Farnworth, 2016). Table 2 shows the details of SMIs used.

Discussion

The purpose of this scoping review was to map the extent of research done in the field of SMI for individuals with mental illnesses.

The current scoping review identified 17 studies that have used SMI on individuals with mental illness with around 13 articles published during 2013 through 2018. The literature on SMIs is at an early stage (Machingura et al., 2018). This increasing trend of studies identified in the current scoping review signifies the increasing interest in the area of sensory modulation in mental illnesses.

Most studies being pilot studies showed that there is an interest in studying and applying the sensory modulation approach in mental health settings. Having only one case control study shows that there is lack of higher-level research with respect to the SMIs for individuals with mental illnesses (Andersen et al., 2017). However, the results also indicate a potential for conducting higher-level research with sensory modulation approach. There is an evolution seen in outcomes measured from earlier studies to the

current studies. Earlier studies have focused more on effects of sensory modulation interventions on distress levels (Novak, Scanlan, McCaul, MacDonald, & Clarke, 2015), the recent study showed improvement in occupation such as public transportation on use of sensory strategies (Wallis et al., 2018). This highlights the role of occupational therapy in improving the functional outcomes using SMI.

SMIs involved items related to visual, auditory, gustatory, olfactory, proprioception and vestibular sensations. The duration of sessions provided ranged from 2 to 30 min for 2 days to 3 years. The ambiguity in the protocol followed could be due to the client centered nature of the SMIs. Developing a protocol for implementation of SMI for persons with various mental illnesses could be beneficial in implementation of SMI in various mental health settings. This would also aid in gauging the effectiveness of the SMI in better possible ways such as through studies with higher rigor.

The facilitators for the use of SMI seem to outweigh the limitations and these interventions fit the client centered practice of occupational therapy (Sumsion & Law, 2006). The therapist will have to assess the sensory profile of the patient to provide the optimal range of sensory items for the person with mental illness to choose from. The aspect of choice in acute settings where seclusion and/or restraint might be used seems very powerful in maintaining the individual's self-esteem, individual identity and autonomy. The SMIs also support the recovery model (Jacobson & Greenley, 2015) that highlights the shift of treatment to increased participation of individuals with mental illness in day to day occupations rather than only symptoms. Moreover, the choice of equipment used during interventions is made by the person with the mental illness by which the individual may feel empowered because of active participation and involvement in the interventions given. Nevertheless, the SMIs are easily adaptable because of which these interventions could be practiced even in the community. Use of SMIs could be a better alternative worthy trying out for persons with mental illnesses before moving on to physical restraints (Moghadam et al., 2014).

Limitations

Only published literature in English was searched in the current review, which may have resulted in missing relevant studies. The reviewers have tried all possible ways to look for relevant articles but individual biases of the authors may not be negated. The current review may help future researchers to conduct relevant research related to gaps identified in the current review. Most of the studies identified in the current scoping review have found that there is a positive effect of SMIs in treatment of mental illnesses. But, there is the risk of bias that invites us to be cautious when interpreting these results. Future studies may focus on

evaluating the effectiveness of sensory modulation interventions specifically on various occupations such as activities of daily living, instrumental activities of daily living, social participation, sleep and rest, education and leisure participation for various conditions in mental illness. Also, studies could be done in developing guidelines in terms of duration and the type of modalities that could be used for persons with different mental illnesses based on their sensory profile.

Conclusion

The current review aimed at mapping the existing literature on sensory modulation interventions for adults with mental illnesses. Based on the identified studies it can be concluded that sensory modulation interventions have the potential in reducing distress levels, and modulating the arousal levels thereby improving the occupational participation of adults with mental illnesses. Moreover, this review would help clinicians in implementing evidence-based decisions in using sensory modulation interventions to treat adults with mental illnesses. Future research should focus on evaluating the effectiveness of sensory modulation interventions in various types of mental illnesses using more randomized controlled trials and longitudinal studies to identify if sensory modulation interventions can bring about a change in sensory modulation in adults with mental illnesses.

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Author's contributions

Ms. Nayantara R. Kandlur, Ms. Ashmica Claire Fernandes, Ms. Suzanna Rupal Gerard, Ms. Shruthi Rajiv and Ms. Shalini Quadros contributed at the initial proposal stage. Ms. Nayantara R. Kandlur, Ms. Ashmica Claire Fernandes, Ms. Suzanna Rupal Gerard, Ms. Shruthi Rajiv conducted the initial search under the guidance from Ms. Shalini Quadros. All the authors contributed towards drafting of the manuscript.

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This scoping review study does not require institutional ethical approval.

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